Australian Bureau of Statistics

1301.0 - Year Book Australia, 1992

ARCHIVED ISSUE Released at 11:30 AM (CANBERRA TIME) 01/01/1992

INTERNATIONAL SPACE YEAR

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As 1992 is designated as 'International Space Year', it is appropriate to review Australia's place and participation in the various fields of activity in space which have increasing relevance for every day life.

SPACE IN AUSTRALIA'S HISTORY

There can be few countries whose history is as closely associated with space as Australia's.

Aboriginal society has continuously observed the heavens for longer than any other culture. Besides creating stories which helped them interpret the relationship between humans, and nature, native Australians also used the changing star patterns to guide them to seasonal food sources. The arrival of Captain Cook's 'Endeavour' along the east coast in 1770 was a postscript to the real purpose of his journey - the observation of the passage of the planet Venus across the face of the Sun, in order to improve the accuracy of methods then used to calculate longitude.

When Governor Phillip led the First Fleet to the new colony of New South Wales in 1788, he was accompanied by the first astronomer of the modern period of Australian history, Lieutenant William Dawes. Dawes made many astronomical and chronological measurements (and the earliest recorded Australian weather observations) from an observatory on the western side of Sydney Cove, and this site soon figured prominently in the early intellectual life of the new colony.

Astronomy

Australia - a pioneer in the science of radioastronomy - has world-famous observatories in this field, particularly the Australia Telescope National Facility hosted by CSIRO. The 30 year old Parkes radio telescope, together with seven smaller and newer radio telescopes at Narrabri and Sidling Springs, form the Australia Telescope Long Baseline Array. Signals from natural radio sources can be collected simultaneously by these sensitive antenna. When operated in this way, the Australia Telescope is much more powerful than any single radio telescope.

Past achievements of the Parkes radio telescope include its prominent role in the discovery of the first Quasar (intense astronomical energy sources, the most distant known), and tracking the encounter in 1986 of the European space probe 'Giotto' with Ha!ley's Comet. Current plans of the Australia Telescope include its use in conjunction with Russian and Japanese-led space missions in the mid-1990s. These will use 10 metre radio telescopes on spacecraft in highly elliptical earth orbit to resolve fine details of quasars and galaxies. Part of the instrumentation for the Russian mission, 'Radioastron', has been designed by CSIRO and made by British Aerospace Australia of Adelaide and MITEC of Brisbane, with the joint funding of CSIRO and the Australian Space

Office.

Other important astronomical facilities, relying on optical observations rather than detection of radiowaves, are also based in Australia. These include the Anglo-Australian Observatory, the UK Schmidt Telescope, and the Mount Stromlo and Siding Springs Observatories. Australian astronomers from these institutions have had a successful history of participation in foreign space observatory missions, such as the US Hubble Space Telescope and the European Hipparcos.

Defence interests

Australia' s military space involvement commenced in 1946 with the Anglo-Australian Joint Project. In its most active period, from around 1955 to 1967, this Project employed thousands of personnel in the township of Woomera and over a rocket test range of some 20,000 square kilometres in central Australia.

Current military space activities continue through the operation of some of the largest satellite ground stations in the world. These, Pine Gap near Alice Springs and Nurrungar near Woomera. are joint United States US) - Australian bases having a total staff of around 1,000, of whom approximately half are American. Pine Gap is a Signals Intelligence station, receiving information from US Ryolite, Vortex, Magnum, Chalet and other military satellites. Commentators have estimated that Pine Gap has a replacement value exceeding $US2 billion. Nurrungar is a control and data processing station for US satellites giving early warning of hostile rocket and missile launches.

A third large military satellite ground station is under construction in Kojarena, near Geraldton. This is wholly under Australian control, through the Defence Signals Directorate. Its capital cost exceeds $100 million.

Australian satellites and payloads

It was from Woomera on Wednesday 29 November 1967 that an Australian scientific satellite, WRESAT, was launched into earth orbit, using a US Redstone rocket. Australia thus became the fourth nation in the world (following the USSR. the USA. and France) to place into earth orbit a satellite launched from its own territory.

WRESAT carried instruments designed and built by the then Department of Supply's Weapons Research Establishment and the University of Adelaide to measure properties of the earth's upper atmosphere, solar radiation, and the temperature of the sun's outer atmosphere or corona. Interestingly, given current concerns about stratospheric ozone depletion, one instrument on WRESAT (which proved to be the only experiment on board to malfunction) was designed to study ozone concentrations at very high altitudes.

Woomera was also the launch site for the UK 'Prospero' scientific and engineering test satellite, on a Black Arrow rocket on 28 October 1971. No further satellites have been launched from Woomera, and most of the range equipment was either destroyed or sold for scrap over 10 years ago.

Proposals have been made to reopen Woomera as a satellite launch site (in addition to suggestions, discussed for about six years, to establish a commercially-operated satellite launch centre on the Cape York Peninsula). To date, however, attempts to re-establish an Australian satellite launching capability remain inconclusive.

Several Australian payloads have been launched since 1967 from overseas locations. These include the OSCAR V amateur radio satellite made at the University of Melbourne (launched 23

January 1970); flights in 1985 and 1988 on the US Space Shuttle of experiments in the aggregation of human red blood cells, designed by the late Dr Leopold Dintenfass of Sydney; and flights of influenza virus crystal growth experiments on the Russian MIR space station and the US Shuttle. The latter experiments were designed by Dr Graeme Laver at the John Curtin School of Medical Research in Canberra.

One of the most significant Australian payloads of the last two decades was the Endeavour prototype ultraviolet space telescope, carried on board the US Space Shuttle on 23 January 1992. The $4.5 million telescope, conceived at the Australian National University, was funded by the Department of Industry, Technology and Commerce and manufactured in Canberra by AUSPACE Ltd. It was designed to collect information on the Magellanic Clouds and other young, energetic astronomical sources of ultraviolet radiation.

Unfortunately, because of the nature of the orbit of the Shuttle which carried the telescope, it is doubtful whether useful scientific information was obtained from the mission. Nevertheless the flight does demonstrate the growing capabilities of a small but significant group of Australian companies which have obtained sophisticated engineering skills as a consequence of space projects funded through the Government's National Space Program, and from the research and development efforts in Universities and CSIRO.

Weather satellites

Australia's regular use of satellites for practical applications commenced around 1963, with the TIROS weather satellite. Routine information from Japan' s Geostationary Meteorological Satellite and the US National Oceanic and Atmospheric Administration (NOAA) series now form an essential part of the Australian Bureau of Meteorology's tool kit for forecasting tropical cyclone intensification and movement, and for general forecasting purposes.

Information from the NOAA satellites is gathered at Bureau of Meteorology, university, CSIRO and government ground stations in Darwin, Townsville, Sydney, Melbourne, Hobart, Perth, Alice Springs and Casey (Australian Antarctic Territory). These satellites are widely used for environmental and oceanographic studies as well as for meteorology.

Communications

One of the most familiar uses of space technology in Australia is in telecommunications. Satellites now carry the majority of international telecommunications traffic from Australia, and television viewers are accustomed to 'live' transmissions of overseas sporting and news events. The first live international television broadcast in Australia was in November 1966, to the UK via the Carnarvon station of the Overseas Telecommunications Corporation (OTC).

OTC currently runs international gateway stations in Sydney. Melbourne, Ceduna and Perth, and also operates an important space installation in Gnangara. near Perth, for tracking and commanding telecommunications and scientific satellites. This work is done under contract to the international satellite communication groups INTELSAT and INMARSAT, and the European Space Agency; and on a collaborative basis with the National Space Development Agency of Japan and with Australian radioastronomers. The US National Aeronautics and Space Administration operates a similar station in Tidbinbilla near Canberra, to monitor and control unmanned NASA planetary missions, and to communicate with the Space Shuttle when it is orbiting above Australia.

Technologies and services developed in Australia are being exported by OTC to clients worldwide, with completed projects in Antarctica, Malta, Vietnam, Cambodia, Laos, and various Pacific Islands.

Growth in satellite telecommunications was so spectacular, and offered such great promise to a large, sparsely populated and remote country like ours, that the Australian Government decided in 1979 to create AUSSAT, one of the first national communications satellite systems in the world. AUSSAT Pty Ltd, a publicly-owned company, quickly established itself as an innovative deliverer of satellite television, telephone and other services and has been responsible for greatly improved outback communications. The first and second in AUSSAT's initial series of three satellites were launched by the US Space Shuttle (27 August and 27 November 1985), and the third by the European Arianespace company on 16 September 1987.

The second series of satellite, known as AUSSAT B, will carry a special L-band channel for mobile communications, and will have a design life of about 13 years in orbit. The two satellites will be launched by the Chinese Great Wall Corporation, from Xichang in south-west China, on the Long March 2E rocket. The first launch, scheduled for March 8, was delayed by a rocket ignition fault, and will be re-scheduled for later this year. The second satellite is due to be launched in August or September. AUSSAT, as one of the first foreign customers for Chinese commercial launches, secured very favourable terms for the launch contract.

Over eight per cent of the components of the AUSSAT B series, in terms of cost, were supplied by Australian companies and CSIRO, under subcontracts to Hughes Aircraft Company of the USA.

A number of factors, not related to the technology itself nor to the high efficiency of AUSSAT Pty Ltd within its prescribed mandate, resulted in poor economic performance by the company. In December 1991 it was sold by the Australian Government to Optus Communications, a consortium of Australian, British and United States companies. At the same time, the Government announced a merger of OTC with Telecom, with the merged body AOTC to compete with the Optus group. The sale to Optus will not affect the AUSSAT B launch plans.

Earth observation

Images of earth taken by space satellites such as the US Landsat and the French/Belgian/ Swedish SPOT are now widely used for environmental monitoring, as well as for mapping and resource exploration. Direct transmissions from these commercially operated satellites are collected on computer tapes at the Alice Springs ground station of the Australian Centre for Remote Sensing (part of the Commonwealth Department of Administrative Services). The tapes are flown to the Centre's office in Canberra, where they are processed into photographs or computer compatible products, and distributed to customers. Images and computer tapes can also be purchased directly from representatives of the satellite operators, such as SPOT Imaging Services in Sydney.

Both Landsat and SPOT rely on camera-like instruments to measure visible and infra-red band radiation emitted or reflected from the earth's surface. Newer earth observation satellites, such as the European Space Agency's ERS-I launched in July 1991 and the Japanese JERS-1 due to be !launched in February 1992, carry powerful radar to 'illuminate' the earth below, regardless of darkness or cloud cover. They gather information about wave and ice conditions, as well as giving images of the 'roughness' of the land surface, which can be related to vegetation conditions, terrain, and soil moisture.

Signals from ERS-I are already being received at the Alice Springs ground station, and data from JERS-1 will also be collected there. A new ground station is being built in Hobart to extend the range of ,earth observation satellite reception over the southern ocean. This is known as the Tasmanian Earth Resources Satellite Station, and is being funded by CSIRO, the University of Tasmania, the Commonwealth Department of Industry Technology and Commerce's Australian Space Office, the Bureau of Meteorology and the Australian Centre for Remote Sensing.

The European ERS-1 satellite carries a number of other instruments, including the Along Track Scanning Radiometer which is designed to precisely measure ocean temperature. Such measurements are important indicators of changing climate patterns. The Radiometer - conceived in part by Dr Ian Barton of CSIRO - was jointly made by the UK, France and Australia, the Australian component being manufactured in Adelaide by British Aerospace Australia with funding support from the Australian Space Office and CSIRO.

Earth observation satellites are an irreplaceable source of information about global resources and environmental change. The Australian Government's investment in ground equipment and research and development programs has helped keep Australia at the forefront of earth observation applications and technology.

INTERNATIONAL SPACE YEAR

1992 is being celebrated as 'International Space Year' (ISY), following the suggestion of the late Senator Spark Matsunaga of Hawaii seven years ago. The ISY has been endorsed by numerous national governments and international organisations, including the UN General Assembly, the International Council of Scientific Unions, and the International Astronautical Federation.

1992 marks the 500th anniversary of the voyage of Christopher Columbus to the Americas, and the 35th anniversary of the International Geophysical Year which saw, in the launch of Sputnik 1 on 4 October 1957. the birth of the Space Age. The linking of these two past events with the International Space Year symbolises the spirit of discovery which is a driving force in exploration as well as in scientific research.

Many countries have set up public associations and scientific committees to promote the International Space Year. In Australia, the Academy of Science established a committee to improve the national coordination and planning of scientifically-oriented activities during the Year, while groups such as the National Space Society of Australia are planning special events to increase public awareness about space.

Senior officials from the world's leading space agencies and research institutions established the Space Agency Forum for the International Space Year to plan cooperative activities. Nearly 30 members and affiliates, including Australia's CSIRO, work together in this Forum. Its major aims are to demonstrate the practical and constructive benefits of space exploration, and to increase these benefits by encouraging international coordination in missions connected with Space Year.

The primary theme adopted by the Forum is 'Mission to Planet Earth', meaning the use of the vantage point of space to observe the earth, the only known home of life. Previous programs of planetary exploration have resulted in the creation of sensitive 'remote sensing' instruments and data handling systems. These are increasingly being applied to the discovery and management of the earth's natural resources and to document changes in the environment due to human influence.

The Space Agency Forum is planning 10 individual projects under the Mission to Planet Earth theme, each under one or two 'lead agencies'. Australia, through CSIRO (with financial support from the Australian Space Office), is leading the Land Cover Change Project of International Space Year.

This project is designed to demonstrate the use of satellite information for observing and understanding vegetation change; and the connection between these changes, climatic influence, and human activities (including urban growth, forestry, and agriculture).

A team led by Dr Dean Graetz in CSIRO's Division of Wildlife and Ecology in Canberra is carrying out the Project, which will result in a video, CD-ROM record and book showing examples

of significant land cover changes in various parts of Australia, as revealed by a twenty-year long series of satellite observations. Lengthy records like these are necessary to distinguish long-term change from that due to seasonal and other short-term climatic vacation.

Australian researchers from CSIRO and several Universities will also join in other 'Mission to Planet Earth' projects during 1992, including global measurements of sea surface temperature using information from US, European and Japanese satellites; and studies of ocean productivity, based upon ocean colour measurements (indicating the concentration of phytoplankton, at the base of the marine food chain).

Australian space-based research commencing in 1992 includes investigations of ocean currents, underwater mountains, and wave heights, using information from the joint French/US TOPEX-Poseidon radar altimeter satellite due to be launched from the Kourou Launch Centre in French Guiana, South America, around July. Other investigations include environmental, oceanographic, mapping and resource assessment studies based on information to be obtained from the Japanese Earth Resources Satellite, JERS-1, scheduled for launch from Tanegashima in southern Japan in February.

Other Australian activities marking International Space Year include a celebratory stamp issue by Australia Post and a commemorative $5 coin from the Royal Australian Mint.

International Space Year represents a period of reassessment of space programs, both internationally and in Australia. Perhaps modern day space explorers can learn from the achievements as well as the mistakes of Christopher Columbus 500 years previously, using information from the frontiers of knowledge to help build a wiser, more prosperous, and more cosmopolitan world.

ACKNOWLEDGMENTS

Information from the following individuals and organisations is gratefully acknowledged:

Ms Jenny Harris, AUSPACE Ltd;
Dr David Jauncey and Ms Helen Sim, Australia Telescope National Facility;
Dr David Griersmith, Bureau of Meteorology;
Mr Paul Tildesley, CSIRO Division of Oceanography;
Mr William Barrett and Ms Jo Williams, OTC;
Ms Keiko Crowley, SPOT Imaging Services;
and Dr Dean Graetz, CSIRO Division of Wildlife and Ecology.

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This page last updated 18 June 2009